

Listing of Claims:

Claim 1 (previously presented): In a data communication network, a method for protecting a node, said method comprising processes of:

identifying a node to be protected;

providing a backup bandwidth pool on links of said data communication network;

identifying a link pair traversing said node to be protected, said link pair having a bandwidth to be protected;

establishing as a backup for said link pair a set of one or more backup paths that do not include said node and wherein said one or more backup paths collectively have backup bandwidth greater than or equal to said bandwidth to be protected;

deducting, for each link included in said set of paths, from backup bandwidth available for protecting said node, while not deducting from backup bandwidth available for protecting other nodes in said data communication network; and

repeating said processes of identifying, establishing, and deducting for a plurality of link pairs traversing said node without exceeding available backup bandwidth of links used in establishing said backups;

wherein said bandwidth to be protected of said link pair comprises a lesser of primary bandwidths of links of said link pair traversing said node to be protected.

Claim 2 (canceled).

Claim 3 (original): The method of claim 1 wherein said bandwidth to be protected of said link pair comprises a total bandwidth of LSPs employing said link pair.

Claim 4 (original): The method of claim 1 wherein said set of one or more paths comprises one or more label switched paths.

Claim 5 (original): The method of claim 1 wherein said processes of identifying and establishing occur under control of said node.

Claim 6 (original): The method of claim 1 wherein said processes of identifying and establishing occur under control of a computer independent of said node.

Claim 7 (original): The method of claim 1 further comprising:
signaling said backups to other nodes adjacent to said node in said data communication network.

Claim 8 (previously presented): A method for operating a data communication network to provide protection to nodes in said data communication network, said method comprising:

maintaining, for each of a plurality of links in said data communication network, a primary bandwidth pool and a backup bandwidth pool; and

establishing backup tunnels to protect a plurality of nodes of said network, each of said backup tunnels consuming backup bandwidth from backup bandwidth pools of selected ones of said plurality of links; and

wherein all backup tunnels protecting any particular node of said network do not consume more bandwidth on any link than provided by the link's backup bandwidth pool but wherein there is at least one set of backup tunnels that protect disparate nodes

and that consume more bandwidth on at least one link than provided by said at least one link's backup bandwidth pool, and

wherein establishing backup tunnels comprises signaling said backup tunnels with zero bandwidth to adjacent nodes of each protected node.

Claim 9 (original): The method of claim 8 wherein at least one of said backup tunnels comprises a label switched path.

Claim 10 (canceled).

Claim 11 (original): The method of claim 8 wherein establishing backup tunnels comprises:

performing backup tunnel selection computations at each protected node for that protected node.

Claim 12 (previously presented): In a data communication network, apparatus for protecting a node, said apparatus comprising:

means for establishing a backup bandwidth pool on links of said data communication network;

means for identifying a link pair traversing said node to be protected, said link pair having a bandwidth to be protected;

means for establishing as a backup for said link pair a set of one or more backup paths that do not include said node wherein said one or more backup paths collectively have backup bandwidth greater than or equal to said bandwidth to be protected;

means for deducting, for each link included in said set of paths, from backup bandwidth available for protecting said node while not deducting from backup

bandwidth available for protecting other nodes in said data communication network;
and

means for repeatedly invoking said means for identifying, establishing, and deducting, for a plurality of link pairs connected to said node without exceeding available backup bandwidth of links used in an establishing said backups;

wherein said bandwidth to be protected of said link pair comprises a lesser of primary bandwidths of links of said link pair traversing said node to be protected.

Claim 13 (canceled).

Claim 14 (previously presented): The apparatus of claim 12 wherein said bandwidth to be protected of said link pair comprises a total bandwidth of LSPs employing said link pair.

Claim 15 (previously presented): Apparatus for operating a data communication network to provide protection to nodes of said data communication network, said apparatus comprising:

means for maintaining, for each of a plurality of links in said data communication network, a primary bandwidth pool and a backup bandwidth pool; and

means for establishing backup tunnels to protect a plurality of nodes of said network, each of said backup tunnels reserving backup bandwidth from backup bandwidth pools of selected ones of said plurality of links; and

wherein all backup tunnels protecting any particular node of said network do not consume more bandwidth on any link than provided by the link's backup bandwidth pool but wherein there is at least one set of backup tunnels that protect disparate nodes and that consume more bandwidth on at least one link than provided by said at least one links backup bandwidth pool;

wherein means for establishing backup tunnels comprises means for signaling said backup tunnels with zero bandwidth to adjacent nodes of each protected node.

Claim 16 (previously presented): In a data communication network, a computer program product for protecting a node, said computer program product comprising:

code that establishes a backup bandwidth pool on links of said data communication network;

code that identifies a link pair traversing said node to be protected, said link pair having a bandwidth to be protected;

code that establishes a backup for said link pair a set of one or more backup paths that do not include said node and wherein one or more backup paths collectively have backup bandwidth greater than or equal to said bandwidth to be protected;

code that deducts, for each link included in said set of paths, from backup bandwidth available for protecting said node, while not deducting from backup bandwidth available for protecting other nodes in said data communication network;

code that repeatedly invokes said code that identifies, establishes, and deducts for a plurality of link pairs connected to said node without exceeding available backup bandwidth of links used in establishing said backups; and

a computer-readable storage medium that stores the codes;

wherein said bandwidth to be protected of said link pair comprises a lesser of primary bandwidths of links of said link pair traversing said node to be protected.

Claim 17 (canceled).

Claim 18 (original): The computer program product of claim 16 wherein said bandwidth to be protected of said link pair comprises a total bandwidth of LSPs employing said link pair.

Claim 19 (original): The computer program product of claim 16 wherein said set of one or more paths comprises one or more label switched paths.

Claim 20 (original): The computer program product of claim 16 further comprising:

code that signals said backups to other nodes adjacent to said node in said data communication network.

Claim 21 (previously presented): A computer program product for operating a data communication network to provide protection to nodes in the data communication network, said computer program product comprising:

code that maintains, for each of a plurality of links in said data communication network a primary bandwidth pool and a backup bandwidth pool; and

code that establishes backup tunnels to protect a plurality of nodes of said network, each of said backup tunnels reserving backup bandwidth from backup bandwidth pools of selected ones of said plurality of links;

wherein all backup tunnels protecting any particular node of said network do not consume more bandwidth on any link than provided by the link's backup bandwidth pool but wherein there is at least one set of backup tunnels that protect disparate nodes and that consume more bandwidth on at least one link than provided by said at least one link's backup bandwidth pool; and

wherein code that establishes backup tunnels comprises code that signals said backup tunnels with zero bandwidth to adjacent nodes of each protected node; and

a computer-readable storage medium that stores the codes.

Claim 22 (original): The computer program product of claim 21 where at least one of said backup tunnels comprises a label switched path.

Claim 23 (canceled).

Claim 24 (original): The computer program product of claim 21 wherein said code that establishes backup tunnels comprises:

code that performs backup tunnels selection computation at each protected node for that protected node.

Claim 25 (previously presented): A network device for implementing a node in a data communication network, said network device comprising:

a processor; and

a memory storing instruction for said processor, said instructions comprising:

code that establishes a backup bandwidth pool on links of said data communication network;

code that identifies a link pair traversing said node to be protected, said link pair having a bandwidth to be protected;

code that establishes a backup for said link pair a set of one or more backup paths that do not include said node and wherein one or more backup paths collectively have backup bandwidth greater than or equal to said bandwidth to be protected;

code that deducts, for each link included in said set of paths, from backup bandwidth available for protecting said node, while not deducting from backup

bandwidth available for protecting other nodes in said data communication network;
and

code that repeatedly invokes said code that identifies, establishes, and deducts for a plurality of link pairs connected to said node without exceeding available backup bandwidth of links used in establishing said backups;

wherein said bandwidth to be protected of said link pair comprises a lesser of primary bandwidths of links of said link pair traversing said node to be protected.

Claim 26 (canceled).

Claim 27 (original): The network device of claim 25 wherein said bandwidth to be protected of said link pair comprises a total bandwidth of LSPs employing said link pair.

Claim 28 (original): The network device of claim 25 wherein said set of one or more paths comprises one or more label switched paths.

Claim 29 (original): The network device of claim 25 wherein said instructions further comprise:

code that signals said backups to other nodes adjacent to said node in said data communication network.

Claim 30 (previously presented): A network device for implementing a node in a communication network, said network device comprising:

a processor; and

a memory storing instruction for said processor, said instructions comprising:

code that establishes backup tunnels to protect a plurality of nodes of said network, each of said backup tunnels reserving backup bandwidth from backup bandwidth pools of selected ones of said plurality of links;

wherein all backup tunnels protecting any particular node of said network do not consume more bandwidth on any link than provided by the link's backup bandwidth pool but wherein there is at least one set of backup tunnels that protect disparate nodes and that consume more bandwidth on at least one link than provided by said at least one link's backup bandwidth pool;

wherein code that establishes backup tunnels comprises code that signals said backup tunnels with zero bandwidth to adjacent nodes of each protected node.

Claim 31 (original): The network device of claim 30 where at least one of said backup tunnels comprises a label switched path.

Claims 32-36 (canceled).